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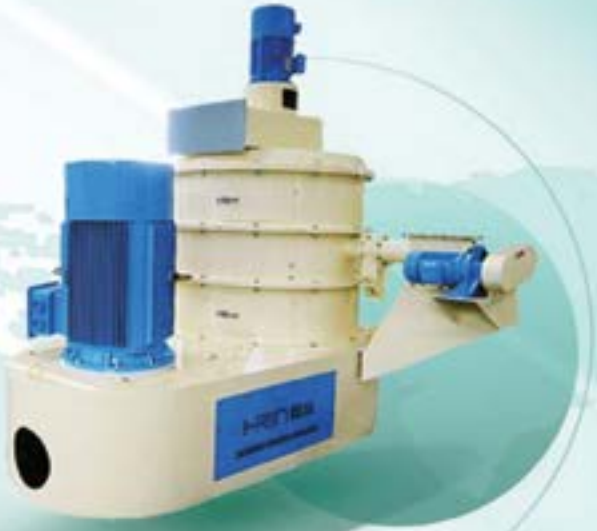

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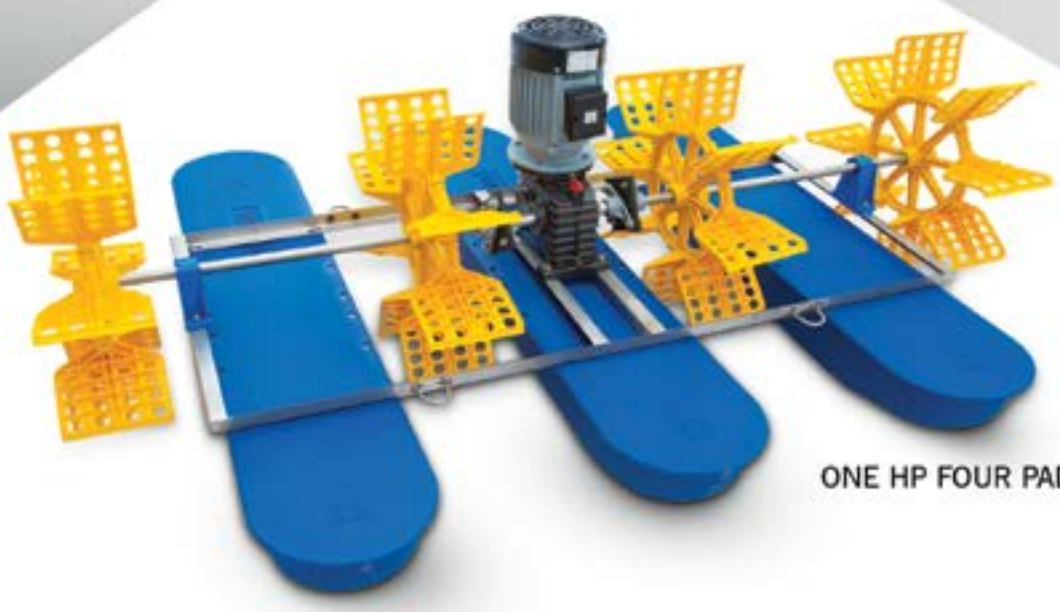

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New Solution for antibacterial, detoxification and intestinal health of shrimp

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I. The present situation and problem of shrimp culture-With the development of science and technology, the cultivation of American White Shrimp(Litopenaeus vannamei) has entered the industrialized era, and the output per unit of cultivation has been increasing year by year.. With the increase of yield, it is faced with a series of problems such as vibrio infection, toxin accumulation, low immunity, frequent diseases (WSSV, EHP, EMS, WFS, etc.), resulting in low growth rate and slow growth of prawn.

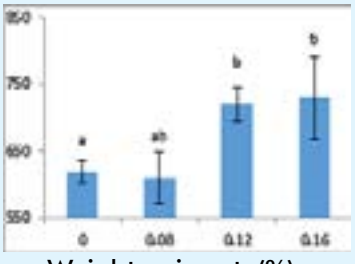
Except for shrimp seedlings, the main reason for the low disease resistance of prawn is that the liver and intestines of prawn are overburdened due to high breeding environment stress and large amount of artificial feed..

II. Bile acids

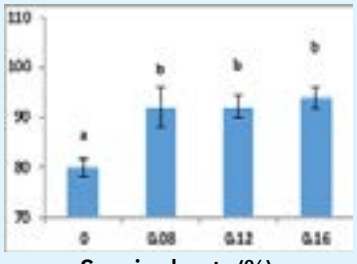
Bile acids is a kind of natural active substance that promotes digestion and absorption of fat and protects the health of liver and gallbladder. In the culture of Litopenaeus vannamei , the antibacterial and detoxifying ability of the shrimp can be significantly improved, the intestinal tract and immunity can be improved, the occurrence of WFS can be reduced, the survival rate can be improved, and growth can be promoted.

1. Improve survival rate and promote growth

It was found that the addition of bile acids can increase the survival rate, weight gain rate and feed coefficient of Litopenaeus vannamei (Li Juntao et al., 2018).



Weight gain rate(%)



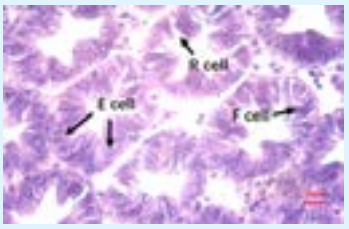
Survival rate(%)

2. Protect the liver structure integrity

The tissue sections showed that the liver and pancreas of the shrimp, which was fed by artificial diet for a long time, were basically intact, but the arrangement was loose, B cells (secretory cells) and R cells (absorbed cells) were less, E cells (blast cells) were more. The basic membrane of the hepatic corpuscle is detached, and obvious blood cell infiltration occurs in the connective tissue between the hepatic and pancreatic lumens. The liver of the shrimp fed with bile acids containing feed was intact, arranged neatly, the epithelial cells were intact, and there was no basis membrane detachment. The star-shaped luminal structure was obvious, and no blood cells were found in the connective tissue between the hepatopan creatic lumen. The number of B cells and R cells were increased significantly, and the number of E cells and F cells (fibrocytes) did not change significantly. the health of the liver and pancreas of shrimp.

3. Improve intestinal flora

Exogenous bile acids have significant effects on the structure and function of intestinal flora of vannamei. After bile acids addition, the microbial flora has changed significantly at the level of phylum, class and genus. Xenobiotics biodegradation and metabolism, Metabolism, Lipid metabolism, amino acid metabolism,



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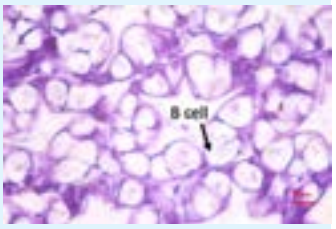


Bile acids group(0.02%)

and metabolism of terpenoids and polyketides, and energy metabolism levels and Biosynthesis of other secondary metabolites have been improved. The change of intestinal flora promotes the digestion and absorption of nutrients, and plays a positive protective role on the intestinal tract, effectively reducing the intestinal flora disorder caused by overnutrition and the intestinal damage of shrimp.

4. Resistance to vibrio harveyi

Vibrio harveyi is a common pathogen in shrimp culture. After a large number of infections, it will cause slow growth or even death of shrimp, which is one of the main bacteria that endangers the successful cultivation of shrimp. The challenge experiment showed that the addition of bile acids in the feed can effectively improve the survival rate of the shrimps under the challenge of Vibrio harveyi with the prolonged attack date.

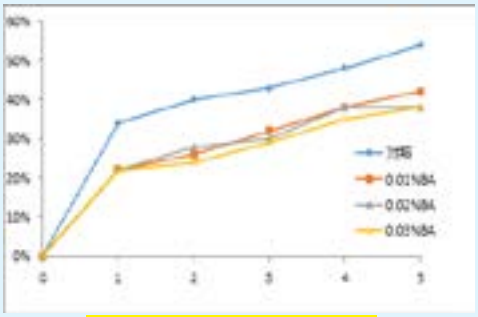
5. Improve detoxification ability

Aflatoxin AFB1 in feed has a serious damage to the liver of vannamei. It can cause a significant decrease in the activity of antioxidant enzymes in the liver and pancreas of shrimp, severe damage to tissue cells, imbalance of intestinal flora, and even death.

After feeding the bile acids added feed, the shrimp was fed with the AFB1 contained feed, and it was found that the addition of bile acids could significantly eliminate the toxicity of aflatoxin on the digestive enzymes of the liver and pancreas of Litopenaeus vannamei. In addition, the addition of bile acids in the feed can significantly improve the activity of hepatopancreas detoxification and metabolism enzymes (CYP450, GST, SULT, UGT) and improve the detoxification ability.

In summary, bile acids maintain liver and pancreas and intestinal health, improve detoxification and improve antibacterial ability, improve the immunity of shrimp, thereby reducing the impact of environmental and bait stress on it, and promoting the healthy growth of shrimp.

It is a New solution for antibacterial ,detoxification and intestinal health of prawn.



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Is Indian Aquaculture an organised sector ?

Two weeks back, a gentleman with fisheries academic background with 25 years of experience in aquaculture sector, and now in a senior position in a company in Chennai had 45 minutes conversation with me over phone about issues of this sector and that he could not get career satisfaction as proper protocols are not followed by the stakeholders, and the industry is not organised even after 30 years of its existence. Earlier to that, similar calls and conversation came from a few others in coastal districts of Andhra Pradesh and Odisha. They told that some of the established stakeholders have concern for their own advantage and well-being, and they do not see the benefit of the industry as a whole.

They asked me being the long-standing Editor in the industry, why don't you try to advice and change the working attitude of the people and the companies in the industry, and also put a word to the stalwarts of this sector and the government to help to streamline and strengthen this sector. I felt there is some logic in their feelings.

In Aquaculture sector, we have four main segments such as the Farmer, Hatchery man, Feed miller and Processor-cum-Exporter with subsidiary segments like Health and Nutrition Products, Aerators and Equipment, Technical Professionals etc. This industry has supporting government agencies like CAA, NFDB, MPEDA, Central and State Fisheries departments, and then Educational and Research Institutions. I don't think there is any other industry in India and overseas with so many supporting government agencies like we have in India. We need to analyse whether we are utilising these institutions sufficiently for the welfare and development of aquaculture sector in the country.

All the segments should understand this industry, their role and contribute their best to streamline and strengthen this sector which is providing nutritious food and employment to the people.

This sector consisting of Shrimp, Fish, Crab and other species production in India should set its own standards and guidelines to have an orderly and sustainable growth.

From broodstock development, seed production to harvesting of shrimps there has to be standard protocol and standards should be maintained in order to achieve goodwill and reputation to Indian shrimp and other species.

When standards are maintained by the producers and other inputs manufacturers, they will gain credibility and the produce "Indian shrimp" will be accepted well on priority with better price.

As some expert said, today, whatever shrimp seed the farmer receives from some of the hatcheries, he is not sure whether it is antibiotic free seed and seed is the only item in aquaculture sector sold at cash and in demand. Proper protocol of quality testing is not possible every time as farmer is in hurry to receive and stock the seed in the ponds.

Farmers should also check themselves if they are observing protocol of pond preparation before the seed is stocked.

In states like Andhra Pradesh, government recently involved telling hatcheries to supply shrimp seed at 35 paise and hatcheries are not satisfied with the recommendation as there is demand for seed. There can be some negotiation by hatcheries on seed price aspect giving their reasons with the assurance of quality seed supply.

Fishmeal, Fish oil and Soya meal, the prime raw material for feed manufacturing are imported from Peru, Chile and other countries paying high import duty / tax.

Many times Shrimp material is sold at ponds at 60, 70 or 80 count and there should be some scientific guidance, and farmers should wait at least till 40 count to harvest.

Poultry industry came out with research findings on broiler chicken that 1800 to 2000 grams live weight chicken will have better tender meat and the producer gets better money.

Similarly there should be some research work to be done on shrimps too. I guess 20 – 40 count weight shrimp will have better tender meat and taste, hence the producer will also get better acceptance and price for the shrimps.

Like the government asked hatcheries to sell shrimp seed at 35 paise, the central government should help the industry by reducing import tax on certain inputs used in seed as well as feed production for some time till this industry is grown and strengthened, and these segments should pass on the benefits to farmers -- and farmers should make shrimp, fish etc available at a reasonable price to the consumers, and ensure smooth and healthy growth of the sector.

Some of the stakeholders are in surge to shoot up their business turnover with more margins not giving attention to long term perspective and for sustainable growth.

We have more unregistered shrimp farmers than the registered in the country, and the government has to ensure their registration soon making them to understand the benefits of registration. Without registration and a certificate no one can do business or an activity like shrimp farming. There is no reliable data and statistics about this sector, and registration can help in this regard.

Farmers were happy when shrimp material production cost was Rs 90 to 100 a kilo live weight a few years back. There is significant rise in the cost of production due to increase in inputs prices time to time.

We have to explain to the bureaucrats about aquaculture and its issues, and they have to understand this industry and come out with proper policy making in the interest of Indian aquaculture sector and its stakeholders for production of quality shrimps and fish. Bureaucrats can certainly help in organising this sector.

Ultimately, it is the self discipline without greed by the stakeholders which can make this sector to have sustainable growth and development. All of us together should give secured feeling to all of us.

There is a need of forming a Body to guide and monitor Production, Usage of advanced technology, Maintenance of quality standards, Branding & Marketing, Statistics, Registration of farms, Promotion of domestic consumption of shrimp and fish, and for sustainable development of aquaculture sector in the country and all over.

M.A.Nazeer
Editor & Publisher
Aqua International

Aqua industry in East Godavari district reels under lockdown

Deputy Chief Minister Pilli Subash Chandra Bose with East Godavari Collector D. Muralidhar Reddy in Kakinada

Deputy Chief Minister leading efforts to sort out hurdles in transportation and manpower

The ongoing nationwide lockdown has dealt a death blow to the aquaculture industry in East Godavari district, with fish in 6,000 hectares on the verge of being harvested finding no takers.

Processing of prawn has also fallen from 650 MT per day to 130 MT per day at the 21 processing plants across the district by Sunday. A grinding halt in the supply of 600 million seeds in the 188 hatchers has further paralysed the industry within the past week in the district, which is home to one-third of the hatcheries in the country.

Deputy Chief Minister Pilli Subhash Chandra Bose is learnt to be leading the State government's efforts to sort out hurdles related to manpower, as many workers have stopped coming to work. The government is also looking to sort out restrictions on transportation

of seeds, feed and logistics, it is learnt.

"China, a major importer of shrimp from India, is believed to be willing to import the shrimp now. The problems in transportation and Export Inspection Agency clearances are being addressed on a war footing," Mr. Bose said at a crucial meeting held with the hatchery firms, feed supply firms and exporters.

According to traders and export agents, nearly 30% of aqua production is exported to foreign countries while the rest of the production in the district is meant for the domestic market.

Mr Bose and Social Welfare Minister P. Viswaroop recently asked East Godavari Collector D. Muralidhar Reddy to persuade the workers to resume duty, as well as allowing transport activities to resume in order to bail out the industry. recently, nearly 110 vehicles including 28 for feed supply have been permitted to ply across the State.

'Bleak future'

Joint Director (Fisheries-East Godavari) Jaya Rao said that crop in 17,000 hectares (including whiteleg shrimp or 'vannamei'), is in various stages of cultivation across the district. "The Export Inspection Agency, Visakhapatnam, has been sought to issue the health certificates for the exports through Visakhapatnam and Chennai ports," Mr Jaya Rao said.

Stakeholders such as owners of hatcheries and feed firms warned of a bleak future, adding that any further delay in speeding up the revival of the aquaculture activity would lead to a collapse of the industry, leaving them with insurmountable losses.

Bayer strengthens presence in shrimp farming sector

Bayer Animal Health has increased its presence in shrimp aquaculture through securing supply and distribution agreements with water treatment technology suppliers, Cytozyme Laboratories and Chengdu Kehonda Technology, as well as farm management technology provider, XpertSea.

The agreements relate to products designed for warm-water pond aquaculture. According to Bayer this now accounts for 55 percent of shrimp produced globally, and most of the operators are mostly small and medium sized producers.

As part of the agreement with Cytozyme, Bayer will commercialise Proquatic Pond Restore, a product that's designed to enhance metabolisation activities in the pond-soil and pond-water environment, in several key aquaculture countries. The product is already part of Bayer's water treatment portfolio in China.

The agreement with Kehonda will enable the rollout of Fetant Complex Iodine Solution technology as part of Bayer Animal Health's portfolio in China and Vietnam. The partnership follows the inclusion of Dyvon PondAcid to Bayer Animal Health's water treatment solution program in China. The product is a pond-water conditioner that supports the quality of phytoplankton populations and maintains levels of dissolved oxygen in the pond water.

The agreement with XpertSea offers smart devices and artificial intelligence-powered software for a comprehensive approach to data-driven farm management, as part of Bayer's integrated services in China, Ecuador, India and Vietnam. The XpertSea devices leverage optics to measure vital pond statistics over time and identify changes in the health of a population. Insights are aggregated into XpertSea's online Growth Platform, which aids producers in making data-driven management and treatment decisions.

"We are proud to be able to play a leading role in offering shrimp producers an application program of non-pharmaceutical pond-water treatment products that make up a comprehensive solution. Together with our partners, we are committed to continue bringing technology to shrimp producers and supporting the sustainable development of the industry," said Jan Koesling, global aquaculture manager at Bayer Animal Health.

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COVID-19 impact on livelihoods of marine fishing communities

The outbreak of COVID-19 and the resultant total lockdown in India has greatly affected the livelihoods of fishing communities across India. The total lockdown may help arrest the spread of corona virus; however, quick and effective intervention is required for fishers to minimize the disruptive effect on the livelihoods of vulnerable population particularly on food systems, storage and market chains, both locally and regionally.

Fisheries in India is an important sector of food and nutritional security. More than nine million active fishers directly depend on fisheries for their livelihood of which 80% are small scale fishers. It employs over 14 million people and contributes to 1.1 per cent of the Indian GDP.

The east coast of India covers 4 maritime states Tamil Nadu, Andhra Pradesh, Odisha and West Bengal and the Union Territories of Puducherry and Andaman and Nicobar islands.Fishing is mainly carried out with traditional fishing crafts, motorized boats and small mechanized crafts. Overall the east coast region produces 25 per cent of total Indian marine landings.

Small scale fishers in India have issues in three areas: pricing, marketing and organization. Many of these are long term needs but there are a few that are immediate and related to the coronavirus.

• Complete lockdown in the harbours and the landing centres has greatly affected the fisher-folks' day-to-day earnings in all coastal districts. Small scale fisheries especiallyare responsible for providing fish as a significant source of protein at low cost for consumers. This is particularly important for marginalized communities and lack of fish in the diet will have considerable impact on nutrition security of these people.

• In some villages near Chennai, small scale fishers fishing near shore areas are struggling to market their catch. Due to physical distancing norms, only few fisherwomen are able to buy fish from the fishermen in the landing centres. Since the time allotted to sell the fish is very short, they are forced to sell their catch at a low price. For example, if the fish rate was INR 500 per kilogram before COVID-19 lock down, the rate now is just INR 300 to 350

• Women fish vendors are considerably affected due to the lockdown as there is no fishing activity and in some places,only limited boats are fishing. The low catch brought to the landing centre is subjected to high demand. Even when few women purchase affordable amount of fish from the landing centre for street vending, due to the pandemic, people are not purchasing the fish. Customers are also seen bargaining for lower price. Due to this, their income has totally reduced and they are facing difficulty to manage their families

• The laborers engaged in the sector are severely affected. Usually fishing laborers take an advance from boat owners during the lean/ban fishing period. But now boat owners too are facing financial problems due to the lockdown. So labourersare finding it difficult to meet family expenses. Those who had migrated from Tamil Nadu to other states like Kerala and Karnataka for fishing activities, are now without work due to the national lockdown.Some fishers have informed that their family is having only one meal per day.

• The trawler fishers who ventured out into fishing before the lockdown (before 20th of March) for multi-days fishing have now returned to the shore. Due to lockdown restrictions they are facing difficulties in market their fish. The fishermen equipped with storage facilities are able to preserve their catch and they have possibilities of marketing their harvested fishes later on. There is another section of fishers who suffer due to lack of storage facilities in marketing their catch and are severely affected. It may be pointed out that a huge quantity of Tuna fish was discarded last week, in Chennai because of unavailability or lack of storage facilities.

• The export market is on standby and because of this, the entire fishing sector, along with its allied sectors,is affected adversely. Since the lockdown from March 25th, fish traders aren't allowed to procure fish and so the export marketing of fish has declined to a great extent. Only fishers are allowed to enter the harbor and that also for a short duration of time (not more than half an hour).

• The supply chain is highly disrupted. Ice-plant workers, diesel workers and youth are jobless. The daily loss is anywhere between INR 500 to INR 2,000.

• The lockdown has affected other fish allied activities like net mending, regular maintenance of boat and engine. This also causes huge damage to the high cost assets like fishing crafts and gears. Many fishing families have expressed that besides income loss;the lockdown has seriously disturbed planned activities such as boat and

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net repair, construction of boats and also in repaying the loans taken for varied fishing purposes.

Recommendations:

Fishers have not ventured into the sea since 20 March 2020. The annual fishing ban period begins on April 15 and will continue till June 15. As a result, marine fishers will effectively not be fishing for nearly 90 days this year! So, there is huge pressure among the fishers, fisher vendors and fishing labourers as a result of the lockdown.

"Suitable adjustments will have to be made to provide immediate relief to the corona affected fishing communities. This should not be connected to regular payments like fishing ban period compensation" Prof M S Swaminathan.

In order to protect the livelihood security of fishing communities, an immediate relief package will have to be rolled out for the fishing communities. This should not be connected to regular compensation provided during the ban season.

Enlarging the scope of work under MNREGS to include skilled work can provide immediate relief. For example, fish drying by women or value addition, processing, net mending can be considered as skilled jobs to be paid under MGNREGS. This will particularly help rural women, including fisher women, who are engaged in a range of tasks for managing the household.

Fisherfolk in villages that fall under municipalities and town panchayats and not just village panchayats, should also be provided similar employment relief, for livelihood security.

The National Fisheries Development Board (NFDB) and fisheries departments of states concerned should come out with a package on priority basis.

lockdown restrictions they are facing difficulties in market their fish. The fishermen equipped with storage facilities are able to preserve their catch and they have possibilities of marketing their harvested fishes later on. There is another section of fishers who suffer due to lack of storage facilities in marketing their catch and are severely affected. It may be pointed out that a huge quantity of Tuna fish was discarded last week, in Chennai because of unavailability or lack of storage facilities.

Kerala: When men in khakhi harvested fish

District police chief K Karthick harvest fish at Koothattukulam

KOCHI: Koothattukulam police had a different agenda last week. Giving a break to their khakhi uniforms, police personnel from the station gathered at their aquaculture farm, nurtured with the support of residents during the lockdown, for harvesting.

Policemen had put tilapia fish in a man-made pond adjacent to the police quarters here and it was looked after by them and members of the janamaithri samithi attached to the police quarter here. District police chief K Karthick joined the policemen during the harvest.

"There were more than 750 large fishes. We used to take care of it during our free time. It was also a community policing initiative as the residents were also part of it," said K R Mohandas, SHO Koothattukulam police station.

On harvest day, senior police officers, including DSP K Anilkumar, residents association members and janamaithri beat officers, were present. SP Karthick said the initiative intends to give a model for the public to follow. "The only way to ensure that we get fresh food is to cultivate them by ourselves. We have to be self-reliant especially during such times. We are sending message through this simple initiative," he said.

The rural police had earlier launched an online 'kitchen garden challenge', in which the cops had challenged residents to send them pictures of their garden. The challenge received a great response and the pictures got featured on the rural police's social media handles. As part of the challenge, vegetable gardens were set up on the police station premises as well.

"The catch was distributed to residents who pre-booked them. The initiative has improved the bond between police and people," said Mohandas.

How Tilapia are tackling malnutrition in Timor-Leste

The second phase of a project that aims to improve tilapia production and consumption in Timor-Leste in order to improve food and nutrition security has recently been launched by WorldFish.

WorldFish is encouraging more families to grow their GIFT strain of tilapia as well as educating people on the nutritional benefits of the fish

As a result, insuring inland communities have access to fish is a major focus of the Partnership for Aquaculture Development in Timor-Leste Phase 2 (PADTL2) project (2020–2023). The project is led by WorldFish, funded by the New Zealand Aid Program, and contributes to the CGIAR Research Program on Fish Agri-food Systems (FISH).

"The project will support farmers by fostering public-private partnerships (PPP) to produce more genetically improved farmed tilapia (GIFT) at less cost and to get it into local markets," said Gabrielle Isaak, First Secretary/Deputy Head of the Mission, New Zealand Embassy in Dili.

"This will enable households to access nutritious fish at affordable prices and include more tilapia in their diets, helping to achieve both national human nutrition and aquaculture goals."

The project will build on the work of phase one, which laid the foundations to grow the country's emerging aquaculture sector.

"Quality fish seed and feed are now available at low cost, farmers know about good aquaculture practices, there's growing interest by key partners in promoting aquaculture, and support is being provided by well-trained extension officers," said the Minister of Aquaculture and Fisheries, Joáquim José Gusmão dos Reis Martins.

"But harvesting and selling fish are not the end of the value chain. We must continue working together to get more fish onto the plates of Timorese families."

"It's only then that Timor-Leste can fully realise the potential of fish farming to enhance food and nutrition security. I'm optimistic this will happen in the coming years."

Malnutrition

Timor-Leste, a county of 1.3 million people, has some of the highest rates of chronic malnutrition in the world.

About 50 percent of children under five years of age are stunted and 37 percent are underweight. Forty percent of women, aged 14–60 years, are anaemic.

Combatting malnutrition is one of the top priorities of the government, as reflected in the Timor-Leste Strategic Development Plan (2011–2030) and the National Nutrition Strategy (2014–2019).

The factors contributing to malnutrition are diverse, but partly due to low dietary diversity and little consumption of animal-source foods.

Increasing fish supply and consumption are seen as key, as shown by the National Aquaculture Development Strategy (2012–2030) which has a goal of increasing fish consumption from 6.1 kg to 15 kg per person per year to improve food and nutrition security.

Vital nutrition

Tilapia is nutritious fish for resource-poor consumers, Dr Shakuntala Thilsted, programme leader, value chains and nutrition explained.

"It's a nutritious food that can improve diets. Many households enjoy eating tilapia, and report that they would eat more of it, if more were available," she said.

Shakuntala added that a diverse diet is vital for maintaining overall health and wellness.

"The bioavailability of micronutrients from plant-source foods also increases if these are eaten with fish."

Coping with Covid

Timor-Leste relies heavily on imports for the supply of major food items - such as grains, meat, fish and other aquatic products - as domestic production is inadequate.

The COVID-19 pandemic has caused disruptions in the import-based food supply chain, exacerbating concerns about the country's food and nutrition security.

"Timorese people will likely suffer from hunger and malnutrition unless the gap between food demand and supply is narrowed by increasing domestic production," said PADTL2 project leader Dr Jharendu Pant, senior aquaculture scientist at WorldFish.

The project, with its focus on increasing fish production using a nutrition-sensitive approach, will help to close this gap.

"Attention will be given to fast-tracking the scaling of aquaculture scaling to bridge the widening fish supply and demand gaps," he said.

"We'll also promote integrated aquaculture-agriculture systems to maximize production of fish, vegetables and fruit, thereby further enhancing the diet diversity and nutrient intakes of households."

Learning about nutrition

A key focus of the project is promoting the health benefits of fish and different ways to cook it.

"We want people to know just how good fish is for their health and to have some nutritious recipes with fish and vegetables on hand that are easy to use," Jharendu said.

In parallel, the project will work with health and nutrition partners to develop and test fish dishes and fish-based products that suit local preferences.

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Fisheries scheme has no relief component

PMMSY plans to double incomes

Giriraj Singh, Fisheries Minister

Though the Pradhan Mantri Matsya Sampada Yojana (PMMSY) was announced as part of the Centre's economic stimulus package in response to COVID-19, it does not seem to contain any components aimed at relief or financial assistance to provide immediate help for the hard-hit fisheries sector.

The PMMSY will increase fish production by 9%, double incomes of fishers and double export earnings by 2024-25, Fisheries Minister Giriraj Singh said at a press conference on Tuesday to announce the details of the scheme. It involves investments of more than Rs 20,000 crore from Centre, the States and beneficiaries over a five-year period.

However, he dismissed the demand for immediate financial assistance for fish workers, especially in light of huge losses during the lockdown, through cash benefit transfer. "This scheme is focused on infrastructure investments that will help fish workers to boost their incomes," he said.

"Due to coronavirus restrictions and previous climate reasons, fishers have not been able to go to sea for several months. Now Cyclone Amphan has also hit fish workers on the east coast and the annual monsoon fishing ban will come into effect in a few days. Given the huge loss of income, we had asked the Centre to give a financial assistance of Rs10,000-

Rs 15,000 a month for each fish worker family," said T. Peter, general secretary of the National Fishworkers Forum (NFF).

In late March, in the early stages of the lockdown, the Fisheries Ministry responded to the NFF's demand by sending letters to the State governments asking for estimates on losses to fishworkers, leading to hopes that the stimulus package would provide such support.

"We have heard nothing further from the Ministry after those initial discussions and the package announced by the Finance Minister has nothing much for small and traditional fishers", said Mr Peter.

Anil T. Varghese from the secretariat of NFF in Delhi said, "The Ministry itself put out a statistics handbook in 2019 with clear estimates of number of fish workers in each State and their average earnings."

Fishing ban

Recently, the Ministry reduced the duration of the annual fishing ban in the monsoon season from 61 days to 47 on the demand of mechanised fishing boat owners, saying it was to provide COVID relief.

"The ban is there for important environmental reasons to ensure that fish spawning can take place during the monsoon and regeneration of fish stock," Mr Peter said.

We will live with Covid-19 for months. Let's not deny it or panic: Dr Faheem Younus

Dr Faheem Younus,

Dr Faheem Younus from the University of Maryland in America, head of the infectious disease clinic tweets facts about covid-19, he tweets we will leave with covid-19 for months. Let's not deny it or panic. Let's not make life unnecessarily difficult. Let us learn to be happy and live with fact.

The virus will not reduce its effect in the spreading it's summer. Its summer in Brazil and Argentina, but the virus is rapidly. You cannot destroy covid-19 viruses that have penetrated the cells by drinking too much water you will just go to the toilet often.

Washing and hands and keeping a distance of 1,8 meters is the best method of protecting against the virus if you don't have a covid-19 patient at home there is no need to disinfect the surfaces in the house.

Cargo packages, petrol pumps, shopping cards or ATMs do not cause infection. Wash your hands live your life as usual. Covid-19 is not a food infection. This is associated with drops of infection like flu. There is no documented risk of covid-19 being transmitted by ordering food.

Entering the sauna does not kill covid-19 viruses that have penetrated the cell. You can lose your smell with many allergies and viral infections. This is a non specific symptom for covid-19.

Once we get home, we don't need to change clothes and shower urgently purity is a virtue, not paranoia. Covid-19 virus does not hang in the air. This is a drip infection that requires close contact. The air is clean, you can walk around the gardens (keeping the distance) in the parks.

Covid-19 does not separate race or religion, it is passed on to all people. It is enough to use normal soap against covid-19 by not necessarily using antibacterial soap. The virus is not a bacteria anyway.

You don't have to worry about your food orders but if you want you can heated up a bit in the microwave. The chance to bring covid-19 home with your shoes and getting sick is the same as getting hit by lightning twice a day I have been working against viruses for 20 years, drip infections don't spread like this.

You cannot be protected from the virus by drinking or eating vinegar, sumac, soda and Ginger. Wearing gloves is a bad idea the virus can accumulate on the globe, it can easily be transmitted if you touch your face. It's best to wash your hands.

Nirmala Sitharaman announces economic package, reforms for farmers & fishermen

The Modi government has divided the 20 lakh crore economicpackage into several tranches
The stimulus is expected to have something in store for all sections of the society

Union Finance Minister Nirmala Sitharaman

New Delhi : Finance Minister Nirmala Sitharaman today released the third tranche of the 20 lakh crore economic package today with a focus on agriculture, fisheries and allied activities. In the previous two parts of the package, FM's focus was on MSMEs, NBFCs, MFIs, migrant workers, street vendors and small farmers. Prime Minister Narendra Modi has declared that the package is aimed at making India self-reliant. He has also hinted at bringing in several reforms to revive the Indian economy hit by the nationwide spread of the contagious coronavirus disease and the prolonged lockdown.

Nirmala Sitharaman press conference highlights:

• Economic package is a mix of liquidity and budgetary measures

• Stock limits to be imposed only under very exceptional circumstances like national calamities, famine after amendment of ECA: FM.

Govt will bring in a facilitative legal framework to enable farmers for engaging with processors, aggregators, large retailers, exporters, etc in a fair and transparent manner. This will ensure assured returns and risk mitigation for farmers: Sitharaman

• A central law will be formulated to provide adequate choices to farmers to sell produce at attractive price, barrier-free inter-state trade and a framework for e-trading of agriculture produce.

• Agriculture marketing reforms to provide marketing choices to farmers

• We want to ensure 100% vaccination of nearly 53 crore animals, a livestock size which is among the largest in the world. Despite Covid-19 lockdown, 1.5 crore cows and buffaloes have been tagged and vaccinated: FM

• No stock limits shall be imposed on processors or value chain participants

• Cereals, edible oils, oilseeds, pulses, onions and potatoes will be deregulated: FM

Essential Commodities Act will be amended to enable better price realisation for farmers: Sitharaman

• Operation Greens' will be extended to all fruits and vegetables. The government has made a provision of Rs 500 crores for the 'TOP to Total' scheme.

• Beekeeping will have a ripple effect on the Indian economy as bees increase the yield and quality of crops through pollination.

• Govt to promote beekeeping initiatives with a 500 crore fund. This will lead to an increase in income for 2 lakh beekeepers and add quality honey to consumers.

Private entrepreneurs, startups who look to facilitate by procuring from farmers and seek to create value addition for the global market, but don't have infrastructure, will benefit from the 1 lakh crore fund: FM

13,343 crore fund launched to ensure 100% vaccination of 53 cr cattles for foot-and-mouth disease: FM

Medicinal, herbal plants can be grown on both the banks of the river Ganga.

• To promote herbal cultivation, 4,000 crore will be allocated to the National Medicinal Plants Board.

15,000 crore will be spent for animal husbandry infrastructure development fund.

Registration of 242 shrimp hatcheries and rearing hatcheries has been extended for 3 months, operation of marine capture fisheries and aquaculture has been relaxed to cover inland fisheries.

1 lakh crore fund being created for Farmer Producer Organizations, aggregators, primary agriculture cooperative societies for strengthening farm-gate infrastructure such as cold chains, post harvest management infrastructure.

Our focus through all the measures is to empower people and improve livelihood, rather than go only on entitlements. The focus is to ensure that India stands up on its own. We are empowering people through creation of logistics and skills: Sitharaman.

• The scheme will lead to additional fish production of 70 lakh tonnes over 5 years.

• 20,000 crore for fishermen through the Pradhan Mantri Matsya Sampada Yojana.

• A new scheme was introduced to give lower interest to dairy cooperatives, the interest subvention scheme will continue and will put additional 5,000 crore in hands of 2 crore farmers

• Cluster-based approach for micro food enterprises.

• Milk was being thrown on streets, since consumers were unable to buy it during lockdown, during this time, 560 lakh litres/day was procured by cooperatives, extra 111 crore litres bought, farmers got paid 4,100 crore: FM

10,000 crore scheme for formalisation of micro

Focus has been on short term crop loans while investment in long term agriculture infrastructure has often not been enough: FM

FM announces 1 lakh crore fund for agriculture infrastructure fund for farm-gate infa for farmers.

• Sitharaman will announce 11 measures today. 8 of them related to strengthening infrastructure, capacity, logistics while 3 of them relate to governance and administrative reforms.

• During lockdown period, demand for milk dropped by 20-25%.

PM Kisan Fund transfer of 18,700 crore

During lockdown period, the minimum support purchases of more than 74,300 crore happened during lockdown

"India is the largest milk producer, largest jute and pulses producer, 2nd largest in sugar cane, cotton, groundnut, fruits, vegetables and fisheries, 3rd in cereals. Indian farmer has really endured and made sure that he would give us the highest yield Sitharaman

It goes to the credit of the Indian farmer who has always stood up to various challenges and has made India reach certain global benchmarks: Sitharaman

The focus of the third tranche is on agriculture and allied activities including fisheries.

FM speech begins.

Stimulus packages will have impact of Rs 1.29

lakh crore on fiscal deficit: SBI

Report

According to market experts, participants fear that the

Continue on page 26

COVID-19 pandemic offers Africa's aquaculture sector an opportunity

The ongoing COVID-19 pandemic has caused seafood prices in Africa to jump, both due to increased supply chain complications and due to inflation. Weakening local currencies have resulted in importers paying higher prices for foreign seafood.

While a negative in the short-term, that increase in price could eventually benefit local aquaculture operations in several countries, according to Skretting Managing Director for Asia and Africa Rob Kiers. Kiers said the disruption of the global supply chain of fish and fishery products, and the increasing import costs, means aquaculture in Africa is likely to "play an essential role in feeding local communities post-COVID-19."

Kiers told Seafood Source that, despite relying on imports, the continent's seafood industry is managing to withstand the effects of COVID-19. That's partly because aquaculture production in the region is largely "destined for local consumption within Africa and not geared for export."

But, Kiers added, for Africa's aquaculture to continue being a critical component of the food chain – feeding local communities during the crisis – countries must strive to "reopen (local) fish markets and small restaurants."

"Currently, supply chain is massively influenced by the lockdowns, causing serious issues in feeding the people," he said.

For Skretting, whose African operations include locations in Zambia, Nigeria, and Egypt, the COVID-19 pandemic has yet to paralyze its business in the region. Kiers said the company is "working closely with our clients on feeding recommendations, to ensure they have options to continue feeding to ensure fish welfare, while minimizing production costs in such uncertain times."

"All our factories have been running continuously and we have implemented safety standard across all factories to ensure continuous production," Kiers said.

However, Skretting, like many key seafood players in Africa, has "experienced issues on supply chain for imported products, but also for local raw materials due to lock-downs, curfews and transport restrictions." Kiers added that those disruptions are still at manageable levels.

He cited the example of Zambia, where the company recently halted production, as there have been export restrictions that are not directly related to COVID-19.

Overall, an optimistic Kiers says the company has not "seen a significant impact on raw materials in Africa, with Skretting operations in Zambia and Nigeria sourcing predominantly local raw materials, hence the limited interruption in supply."

Nevertheless, in the North African market, Egypt has "been a bit more challenging, with some ingredients coming from overseas."

"We do expect [an increase] in impacts [of COVID-19], as the supply of byproducts from food and fuel will become less available going forward," Kiers said.

Currently, because of the increasing COVID-19 cases, many governments have partially closed borders and imposed quarantines on visitors entering the country, causing massive disruptions to the seafood supply chains and trade. This trend has resulted in people having difficulty accessing a sufficient fish supply in the interim.

On the flipside, Kiers said small-scale aquaculture farms "may benefit from reduced competition as focus changes to local supply over imports."

"The global COVID-19 pandemic will force every country to take further, decisive action in many areas which also pres ents an opportunity for aquaculture stakeholders to rise and put in place measures to protect and keep fish production and supply chains alive and mitigate the pandemic's impacts across the aquaculture value-chain," he said.

Going forward, Kiers' projection is that "uncertainty still dominates the outlook, particularly with regard to the duration and severity of the pandemic."

Indian start-up gets global recognition for initiatives to support aquaculture farmers

Aquaconnect, a Chennai based aquaculture technology venture, has been recognised as one of the Fast Company's World Changing Ideas 2020 for its AI-backed innovations in the field of aqua-farming.

The World Changing Ideas Award is a global award dedicated to honouring businesses, policies, projects, and concepts that are actively engaged in flattening the curve of the climate crisis, social injustice, or economic inequality.

Aquaconnect is one of the few Asian start-ups to have received the recognition amongst 3,000 entries.

The company stated that it aims to innovate in the field of aquaculture technology by providing an Artificial Intelligence-driven mobile advisory solution, Farm MOJO, to Indian shrimp and fish farmers.

Aquaconnect's Farm MOJO mobile app uses machine learning technology to analyse feed and growth patterns in relation to animal health. The app provides insights to farmers and suggests appropriate advice for better disease management, the company said.

Aquaconnect received this special recognition for an initiative that aims to enhance Farm MOJO's disease prediction model in collaboration with Prof. Kenton Morgan and IDH, The Sustainable Trade Initiative.

This project targets to link aquatic epidemiology to the sector and benefit 120 ha of farm area in India in the next two years.

Considering these initiatives, Aquaconnect has been selected as an honoree of Fast Company's World Changing Ideas Awards 2020.

Rajamanohar Somasundaram, CEO, Aquaconnect stated in an official statement: "We are honoured and delighted to recognised as one of Fast Company's World Changing Ideas. It is an endorsement for our initiatives to promote AI for sustainable aquaculture practices. Our aim is to continuously evolve with futuristic technologies that facilitate best solutions for problems in the aquaculture sector."

The company had previously won the Indonesian Seafood Innovation Project award in 2019.

The company is a brainchild of Rajamanohar Somasundaram, who is popularly known as the Aquaman of India, for making the AI-driven farm advisory tool more accessible to farmers in the rural and coastal regions of the country. The World Economic Forum recognised him as a 'Young Global Leader in 2012', considering his leadership and contribution in the field of mobile communication and information services.

Through his venture, Aquaconnect, Raj and his team are promoting sustainable aquaculture (growing fish and shrimp) through technology interventions and he envisions Artificial Intelligence Technology, IoT, and satellite remote sensing, which could improve the productivity of the Indian aquaculture industry and make India the world's aquaculture hub.

Nirmala Sitharaman announces economic package, reforms for farmers & fishermen

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Rs 20 lakh crore package may not result in direct and immediate

boost to demand, raising

doubts over the country's economic revival in the near term.

Sitharaman said, "If we do not speak about a certain component today, it does not mean that the government has forgotten about any particular segment, more initiatives are being announced".

• Today is the third consecutive day when the finance minister is doing a press conference

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CMFRI helps SC families in Tamil Nadu Village earn additional income through seaweed and ornamental fish farming

The ICAR- Central Marine Fisheries Research Institute (CMFRI) has successfully implemented Government of India's Scheduled Caste Sub-Plan (SCSP) project in such a way that helped the SC families in Puthukudi village, Thondi, Thiruvadanai Taluk in Ramanathapuram district of Tamil Nadu to empower themselves through seaweed and marine ornamental fish farming. In a major success story, the Mandapam Regional Centre of ICAR-CMFRI already made this villagers capable of earning an additional income of Rs 96,000 annually through seaweed farming which is a highly de sired farming practice by the Hon'ble Prime Minister Mr Narendra Modi for the prosperity of the coastal community, and the Institute's efforts are underway to help them reap profit through other forms of mariculture like marine ornamental fish seed rearing.

Group members holding harvest

Seaweed farming

Located near the sea shore, Puthukudi village has 97 per cent of SC families (Kadiayar community) in the total village population and majority of them involved in fishing in Palk Bay. The ICAR-CMFRI launched the initiative of empowering the villagers through SCSP by giving them an awareness-cum-training programme on mariculture technologies for diversified livelihood in September 2019. A total of 28 fishers in 10 groups, were selected for undertaking seaweed farming of Kappaphycus alvarezii under the SCSP component of the Institute, AINP on Mariculture and NICRA projects. The Puthukudi coastal area is less in wave action, shallow depth and less planktivorous fishes, which are ideal for monoline seaweed method. Each fisher was given 20 monoline units. The cost for making one monoline unit is Rs.1,600/- and the entire cost for making 575 monoline units was borne under the SCSP component of the projects. Seaweed farming of Kappaphycus alvarezii was initiated during the second week of November, 2019 with 20 monoline units. The total fresh seaweed production from three cycles was around 90 tonnes. Since entire start-up cost was met under the SCSP project and each fisher will earn Rs.96,000/- annually around Rs.10,000/- per month with five crops in a year depending on the climatic conditions.

Marine ornamental fish culture

A total of 18 fisherwomen in 6 groups, were selected for undertaking marine ornamental fish seed rearing under the SCSP component of Institute and AINP on Mariculture. The Mandapam Regional Centre of ICAR-CMFRI had established six sheds (each 216 sq.ft. area) along with all accessories. Initially two sheds were commissioned by Shri. K. Muraleedharan, Member, Institute Management Committee of ICAR-CMFRI in the presence of Dr R. Jayakumar, Scientist-in-Charge, scientists of Mandapam Regional Centre and fishers of Puthukudi village on 3rd June 2020. The Mandapam Regional Centre of ICAR-CMFRI has provided 600 numbers of clown fishes in 3 varieties to each group (total of 1,200 clown fishes of 2cm size). The SHG will become capable of selling the fishes after rearing about 30-45 days. A group can earn around Rs.30,000/- per month.

The ICAR-CMFRI also helped the beneficiaries linking themselves with the marketers for both seaweed and marine ornamental fish sale. Joint bank account for each group was opened at Canara Bank, Thondi. This is the first Government livelihood improvement initiative for fishers in the Puthukudi village. The fishermen are hopeful that the income through these diversified livelihood options will be very useful in improving their standard of living.

Releasing the fish seeds

Growth of the seaweed

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MPEDA to produce GIFT seeds in Kerala

Kochi: Rajiv Gandhi Centre for Aquaculture (RGCA), the research arm of Marine Products Exports Development Authority (Mpeda), is planning o start growing Genetically Improved Farm Tilapia (GIFT) seeds at its multi-species aquaculture complex at Vallarpadam, Kochi, from June to support the fish farming community in Kerala.

GIFT is a high-yielding strain of Tilapia originally developed by the World Fish Center, Malaysia, which is currently being selectively bred at the Vijayawada facility of RGCA.

When contacted, TG Manoj Kumar, head of the RGCA facility in Kochi, said: "During the last financial year, we sold 3 million GIFT seeds from our Vijayawada centre through the Vallarpadam facility. This fiscal, we are targeting 5 million seeds. From June to October, we will supply GIFT eeds produced at Vallarpadam and from November to March, the seeds will be brought from Vijayawada."

Farmers in Kerala need to maximize their stock during monsoon, but during the April - August period, Vijayawada will stop the commercial breeding due to high temperature. Hence, the solution for RGCA was to produce seeds locally to meet the local demand.

Apart from producing seeds from its own facility in Kochi, RGCA is serving as a consultant to the department of fisheries in Kerala to set up two GIFT breeding centres at Neyyar, near Thiruvananthapuram and Pannivelchira, near Kozhencherry.

Authorities said that the only authentic GIFT in in India is the one supplied by RGCA. Currently, RGCA is supplying only 4 million seeds to Kerala and an additional 2 million through Tamil Nadu government's aquaculture facility in Krishna Giri, leaving the demand gap at 6 million seeds. This gap is met by suppliers from West Bengal

Tilapia farmers in Kerala had been finding it difficult to source quality seeds and many had been duped with other strains of Tilapia. When TOI contacted one of the seed suppliers in West Bengal, he sent photos of seeds claiming to be that of GIFT. He also offered mono-sex Tilapia (MST), another variant coming from Kolkata in large numbers, recently.

Ashok P Thomas, a fish farmer from Anchalpetty near Muvattupuzha, had a bad experience growing MST last year. The seeds he grew achieved only 40% to 50% growth. "After growing thousand seeds for five and a half months, I got only 160 kg in total," he said.

N P Vijayakumar, a retired project administrator who had worked across continents, had been growing GIFT from 2017. According to him, this variety is tastier than others and has huge demand locally. " Also, the GIFT provided by RGCA is disease-free," he said.

Nutrex NV appoints Dr Amit Kumar Patra as TSM - South Asia

Dr Amit Kumar Patra, TSM - South Asia

Kolkata: Nutrex NV, Belgium has appointed Dr Amit Kumar Patra as Technical Sales Manager - South Asia (India, Bangladesh, Nepal and Srilanka). He will report to Belgium office.

Dr Amit completed M. V. Sc in Animal Nutrition at West Bengal University of Animal & Fishery Sciences, Kolkata. He has been involved in Poultry and Dairy industries for more than 15 years before joining Nutrex. Dr Amit comes with his expertise and knowledge of the South Asia market to reinforce Nutrex business in the region.

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Bacterial strains such as Bacillus Subtilis, Nitrobactor, Nitrasomonas, rapidly converts ammonia into Nitrates, Nitrites and finally non-toxic Nitrogen. Hydrogen Sulphide converts into Sulphates, Sulphites and finally non-toxic Sulphur, Methane into Non-toxic carbon. This conversion reduces the obnoxious gasses in the pond bottom. Reduction of this gasses improve the D.O. level in the water and bottom.

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An Insight to Raft and Rack Culture Systems

Highlighted

Raft and rack culture systems are traditionally practiced along the coastal area for rearing of shellfish and molluscan species. However, success in any farming systems can be achieved when the farming communities knows about the proper site selection, construction, management and challenges involved in a particular production systems. The present article deals about the site selection, construction of raft and rack, construction materials used, merits and demerits of raft and rack systems and challenges involved in raft and rack systems.

Somu Sunder Lingam, R*., Chidhambaram, P., Stephen Sampath Kumar, J. and Felix, S

Introduction

Aquaculture – the contributor of half of fish production in the world - is an age old fish rearing practice adopted throughout the world in all water bodies. The evolution of supplementary feed and modern intensive fish culture practices in 1980's divided the aquaculture practices into two broad categories, fed and non-fed aquaculture systems. In the first system, stocking density of fish was increased in captive condition with the supplementation of pellet feed. On the other system, aquatic animals and plants, mostly reared in their natural habitats, were raised without any supplementary feed. Comparatively, in the ecosystem point of view, practicing of non-fed species aquaculture has more advantageous than the fed-species culture. However, the annual growth of fed species culture has outperformed than the non-fed species culture. Further, the non-fed species culture system has been divided into two sub-systems, rearing of filter feeding finfish and aquatic invertebrates and seaweeds.

The present global production of unfed species is 24.4 mt, with a share of 30% in the total farmed food fish. In the unfed species production, filter feeding finfish contribute 8.8 mt and aquatic invertebrates has a share of 15.6 mt (FAO, 2018). Mostly, the unfed aquatic invertebrates and seaweeds are reared in open seas, lagoons and coastal areas using the rack and raft culture methods. In these culture method, mostly shellfish (mussel, oyster, scallops and clams) and seaweed species are cultured following the extensive aquaculture principles in the open waters, commonly in marine environment. Raft and Rack culture are mainly used in grow out phase where either shellfish reared from spat to harvestable size or seaweed reared from seedlings to marketable product. In general, rack and raft culture systems fall in the off bottom culture method, a culture system in which growing spat/seedlings do not have any contact with ocean floor/estuary bottom. Mostly, rack culture system is more suitable for tidal-less area where the influence of wave and tidal actions are minimal such as estuaries and backwaters. The other counterpart culture, raft systems, is highly preferred in open sea conditions. In India, raft and rack culture methods are only practiced by fisher's community along the coastal waters, especially in northwest (Gujarat), southwest (Kerala) and southeast (Tamil Nadu) coasts.

RAFT CULTURE

Rafts are suspended strings from any floating structures such bamboo, cedar, barrels and casuarinas. Wooden poles are laid parallel to each other about 0.5 m and fastened by wire/rope to lateral beams (Fixed Raft).

A framework of timber supported by floats, with a series of ropes attached within the framework of the raft (Floating Raft). It is normally 18 m long and 9 m wide.

Types of Rafts

1. **Raft for tube or string type:** Raft frame is like tube and made up of PVC pipe. It is operated in Rendora sea farm in USA and Canada. Suitable for deep water operation.
2. **Raft for tray system:** In the raft frame, a tray like structure is constructed to stock the seeds. It is mainly used in the nursery phase of bivalve rearing. Used in Rendora sea farms.

3. **Anchoring type:** The wooden poles are driven into the ocean floor to avoid the drifting or movement of raft from one place to other due to wind and wave actions. Recommended for the places where rough wave/tidal actions are noticed.
4. **Single rope floating raft:** Each main rope from the frame of raft is anchored with separate anchor to give more strength to the unit.
5. **Square block floating raft:** A square shape floating raft is anchored in sea bottom from four corners of the raft. This system is not strong as that of single rope system.

RACK CULTURE

It is a type of hanging rope culture practiced in shallow waters. Rack is constructed by driving the wooden pole in sea bottom up to 2-4m. Then these upright poles are connected by one horizontal pole or line. Rens are placed in the horizontal pole at a distance of 30cm.

Types of Rack culture

1. **Vertical rack system:** In this method the cultch are placed vertically from the main line.
2. **Horizontal rack system:** The rens or cultch are placed horizontally between two vertical poles.

Parts of Raft and Rack

i. Frame: It is made of any wooden materials and it is present only in raft system.

ii. Pole: In rack culture, raft frame is replaced by two vertical poles.

iii. Main Line: A line connected in between frame (raft) or in between poles (rack).

iv. Secondary Line: A rope line containing seeds (cultch) and it is attached with main line.

v. Float: It is connected in the main line to keep the culture unit in suspension.

vi. Anchors: It may be either connected with frame or cultch to keep the culture unit in a particular place.

Raft Culture	Rack Culture
It may be fixed or suspended.	It is fixed.
A Frame (raft) is made up wood or any floating materials	Frame is absent. Two wooden poles are present.
More Than one Parallel lines or woods are tied in between the frame.	Only one parallel line is present
It is placed in inner side of the farm.	It is placed in outer side of the farm.
It can be operated in any type of bottom.	It is suitable only in soft and muddy bottom
Suitable for deeper water.	Operated in low depth (2-4 m) waters.
Investement is high.	Investment is low

Species cultured in Rafts and Racks

1. **Oysters:** Edible oysters such as Crassostrea gigas (Pacific oyster– Japan), Ostrea angasi (Mud or Flat oyster- Australia), Crassostrea madrasensis (Indian oyster – India) and Saxostrea cucullata (Rock oyster – India) are cultured. In pearl oyster, species such as, Pinctada fucata (Indian pearl oyster – India) and Pinctada margaritifera (Black lip oyster – Andaman and Nicobar Island) are cultured.
2. **Mussel:** Mytilus trossulus (Bay or Foolish mussel – Scotland), Perna canalicula (Green lipped mussel – Australia), Perna indica (Brown mussel – India) and Mytilus edulis (Blue mussel – India).
3. **Clams:** Tridacna derasa (Southern giant glam) – Indonesia), Hippopus porcellanus (China clam – Philippines), Paphia malabarica (Short neck clam – India) and Anadara granosa (Blood clam – India).
4. **Sea weeds:** Porphyra (Red algae – Japan), Laminaria (Brown algae – China), Kappaphycus (Red algae – India) and Gelidiella (Red algae – India).

vii. Anchor Line: A line used to connect the anchor and wooden frame in raft culture unit.

Site selection for raft and rack culture

In any aquaculture activity, site selection plays a major role which decides the success as well as operational

cost to run the culture. However, a suitable site will be selected based on various criteria which needs experience and scientific knowledge. While selecting the site for raft and rack culture the following features are considered i) species to be cultured, ii) method to be used, iii) inspection during culture operation, iv) harvesting method, v) stocking density, vi) flotation, vii) anchorage and viii) cost.

Factors affecting site selection

Primary factors: These are the factors that prevalent in the culture site and directly affect the production of the culture system such as substratum (sea floor), water depth, tidal currents/wave actions, nutrient availability, water temperature, turbidity and transparency and other water quality parameters.

Secondary factors: These are the factors that prevail in and around the culture site such as possible chance of environmental, poaching, resource competition and economic considerations.

Construction

1. **Raft**

- Make the frames with bamboo or any other wooden materials.
- Tie the main line in wooden frame and connect the floats.
- Prepare the secondary line (cultch) and join the secondary line with main line.
- Shift the raft into open sea and make anchorage in sea bottom.
- This whole process can be done during low tide.

2. **Rack**

- Take two wooden or steel poles.
- During low tide lay the poles parallel to each other in sea bottom.
- Then connect the two poles by a horizontal line (Main line) and add floats.
- Prepare the secondary line (cultch) and connect with main line.

Construction principle

1. **Floatation:** It gives suspension or floatation to the culture unit. Floating capacity should be planned as per the estimated final output of the culture unit. Block foam is the standard floatation material. The major problem in deciding the flotation is the attachment of borers and fouler which may add additional weight to the estimated final output weight.
2. **Strength and flexibility:** The culture unit should not be affected by wave, current and wind activities. Too rigid structure may create more damage to the unit. The unit need to move like "Z" without compromising its strength and permanency, to avoid the damage caused by waves and currents.
3. **Functionality:** The system should be efficient and convenient for maintenance and harvesting. Some platforms or walk way need to be placed on the raft to afford the safe working conditions and simplify the harvesting.
4. **Durability:** Minimum life span should be 5 or more years. It depends on the site conditions especially natural forces which are prevailing at the culture unit.
5. **Capacity:** The system must support high stocking density and maximum production. It varies based on climatic conditions of the culture site.

Materials for construction

1. **Bamboo:** It is used to make frame (raft) or pole (rack). It must be simple, weightless and easily available. Commonly used woods are Bamboo poles/ Eucalyptus/ Steel poles. In raft culture bamboo or eucalyptus woods are used. In rack culture steel poles are used.
2. **Ropes:** It should be strong and non-corrosive. It is used to make adjustments in water depth and to keep culture unit together throughout the farming. Generally, ropes like nylon, palm coir rope, and poly ester ropes are used.
3. **Floats:** It provides suspension and also act as a marker for identification of unit. High cost is required. In one culture unit, 20-40 number of floats are used. Styrofoam is effective. Steel drums painted with antifouling and rust preventive are also used.
4. **Anchors:** Used to keep the raft and rack in a particular place and to avoid the drifting of units from winds and waves. Too tensed anchor leads to breakage of unit under severe conditions. Too relaxed anchor leads to twisting of ropes. Commonly used anchors are concrete bricks, stones and steel. In raft culture, 2-4 anchors are used whereas in rack two poles are used as an anchors

Maintenance:

- Visit the farm 2-3 times in a week.

- Remove the undesirable algae, barnacles and sediments attached on the ropes.
- Check and tighten the loosen ropes and clutches.
- Assess the signs of diseases.
- Advantages
- Low initial investment and high production,
- Scarcity of land and water can be resolved.
- Easy to construct, operate and requires less maintenance.
- Labour intensive is less and no need of feed and fertilizers.

Problems

- Attachment of boring and fouling organisms over the culture unit.
- Chance of bio toxins (PSP, DSP, NSP).
- It may create conflict in navigation and local fishing (resource competition).
- Biota destruction during site preparation.
- Sedimentation of organic matter at the bottom of culture unit.
- Poaching by local people.

Conclusion

In the context of modernisation, every production sector in the world, including aquaculture and other food producing sectors, are implementing advanced technologies to sustain their production. In contrast to this, till now, there are certain production systems/technologies which are not much modernized and yet practiced as it was followed in their earlier days. Rack and raft culture systems are such kind of simple, effective, low cost and high production systems. More importantly, these systems are highly suitable for livelihood option of the economically backward people located at the coastal areas. Further, the demand for resource efficient shellfish farming systems and market demand for shellfish products are growing at an increasing rate. On the other side, the share of non-fed species, produced through rack and raft culture, in total food fish production has decreased from 50% in 1980 to 30.5% in 2016, which placed an additional pressure to our exhausting resources. Hence, the wise use of our blue resources, ocean and marine, through the adaptation of rack and raft culture systems could help to achieve the shellfish production in a more sustainable way.

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References can be provided on request

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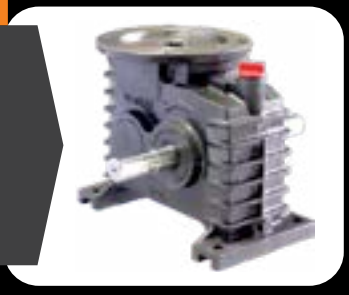

Type : A3 Aero RF (Aluminium)

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Pedals : 4, 6 & 8
O/p RPM : 105 & 120
Power savings : 75%
Aluminium housing with Anti-rust coating

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Power savings : 70%
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2 hp = 12 Pedals
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Endocrine and Reproductive physiology in fishes

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Highlight Points

- Hormones are chemical messengers created by the body. They transfer information from one set of cells Hormones are chemical messengers created by the body. They transfer information from one set of cells to another to coordinate the functions of different parts of the body.
- The major glands of the endocrine system are the hypothalamus, pituitary, thyroid, parathyroids, adrenals, pineal body, and the reproductive organs (ovaries and testes).
- It will also help to develop strategies for advanced maturation and prolonging the breeding season of candidate species.

Introduction

The endocrine system is made up of glands that produce and secrete hormones, chemical substances produced in the body that regulate the activity of cells or organs. These hormones regulate the body's growth, metabolism (the physical and chemical processes of the body), and sexual development and function. The hormones are released into the bloodstream and may affect one or several organs throughout the body. Endocrine glands are ductless glands that produce and release hormones to the blood through diffusion. They can be categorized into three types

1. Discrete endocrine glands: It includes the pituitary, thyroid, and pineal gland.
2. Organs containing both endocrine and exocrine. In fishes, it includes kidney gonads and intestine.
3. Scattered cells with endocrine function. They are also known as diffused endocrine glands. They are generally called paracrine which is normally present in the intestine.

Chemically hormones can be divided into three classes:

1. **Steroid Hormones:** Testosterone and Estradiol
2. **Protein Hormones:** Hormones secreted by pituitary, thyroid, internal tissue, and pancreatic tissue.
3. Amino acid analogs: Catecholamines

Steroid hormones differ from peptide hormones in terms of the presence of receptors. Steroid hormones have their receptors in the cell cytoplasm as they can pass through lipid bi-membrane

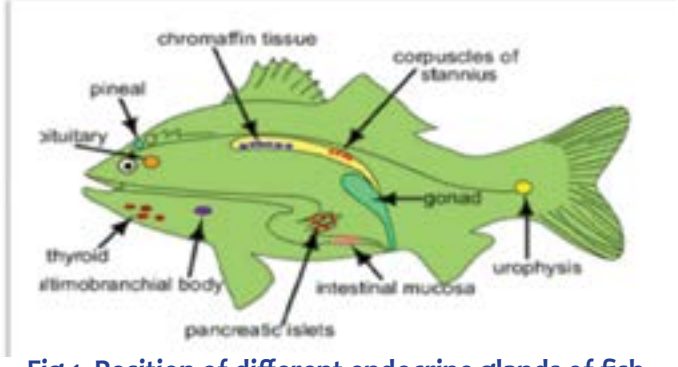
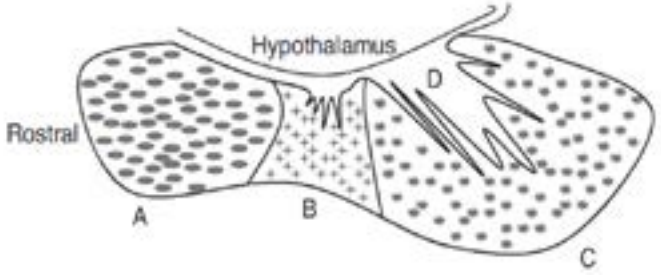


Fig.1. Position of different endocrine glands of fish

and protein hormones have their receptors present on cell surface on the cell membrane.

Major endocrine glands of fishes its location and secretions:-



In this Fig. 2, those marking denotes the position of a different portion of Adenohypophysis

Fish pituitary: Often referred to as master endocrine gland. This master endocrine gland originates embryologically from the two sources. One as ventral down growth of a neural element from the diencephalon called the infundibulum to join with another, and ectodermal up-growth from primitive buccal cavity. The pituitary gland is located below the diencephalon, behind the optic chiasma and anterior to saccus vasculosus. The pituitary has two parts adenohypophysis and neurohypophysis former being glandular and later neural. Adenohypophysis further divided into rostral pars distalis, proximal pars distalis, and pars intermedia.

A: Rostral pars distalis

B: Proximal pars distalis

C: Pars intermedia

D: Pars nervosa of the neurohypophysis

Secretion from different portions of the pituitary gland:

1. Pars intermedia: MSH
2. Proximal pars distalis: FSH, LH, GH
3. Rostral pars distalis: PRL, ACTH

GnRH immunoreactive fibers are mostly present in proximal pars distalis (PPD). Chemically these hormones are protein or

Gland	Secretion of hormones
Pineal organ.	Melatonin
Thyroid	MIT,DIT,T4
Chromaffin tissue	DOPA,5-HT
Corpuscles of stannius	Calcium regulating factor, potassium regulating factor
Ultimobranchial organ	Calcitonin
Urophysis	Urotensins
Pancreatic islets	Glucagon, Insulin, Somatostatin, Pancreatic polypeptide

glycoproteins.

Hypothalamus: its secretions and role in reproduction

Hypothalamus secrets Gonadotropin-releasing hormone (GnRH) which acts on the pituitary. GnRH is a decapeptide extended at the amino terminus by a signal peptide and at the -COOH terminus by a Gly-Lys-Arg residue followed by GAP. It Controls the synthesis and release of GTHs. 5 types of GnRH receptors have been identified so far. GnRH-2 has been shown to influence the melatonin release from the pineal gland.

GnRH stimulates the synthesis and release of pituitary gonadotropins, follicle-stimulating hormone, and luteinizing hormone to control gametogenesis and sex steroid production. Originally considered and named for its important reproductive function, two related GnRH gene-encoding decapeptides (GnRH), which are not directly involved in the HPG axis, have been identified invertebrates. Within this family of three genes, more than 10 GnRH peptide variants have been identified.

Molecular phylogeny of GnRH ligands shows that there are three distinct forms, GnRH1, GnRH2, and GnRH3 that arose from a common origin. To date, GnRH3 has only been found in teleosts. Interestingly, the decapeptide sequences of GnRH2 and GnRH3 are completely conserved across vertebrate species, whereas the GnRH1 sequence has diverged in the vertebrate lineage. GnRH forms not only regulate reproduction but also clearly have other physiological roles based on their expression patterns, despite relatively limited functional testing. In general, GnRH1 neurons are located in the preoptic area of the hypothalamus and project predominantly into the pituitary, where they regulate reproduction via gonadotropin release. In addition to its primary role in regulating reproduction, GnRH1 has also been shown to cause the release of growth hormone from the pituitary (Marchant et al., 1989) as well as regulating prolactin (Weber et al., 1997) and somatolactin (Kakizawa et al., 1997). GnRH2 is produced in the midbrain tegmentum near the third ventricle, and GnRH2 neurons project throughout the brain, especially midbrain and hindbrain, as well as having terminals in the third ventricle directly.

Other Brain Factors Stimulating GTH release:

- **Neuropeptide Y:** Influences GTH release by influencing cross-talks between growth, feeding, and reproduction axes.
- **GABA:** Inhibitory neurotransmitter abundant is the hypothalamus. GABA inhibition caused a dose-dependent increase in the GTH level. The effect of GABA on GTH release was abolished in E2 treated females but was still observed in T-implanted fish.
- **GnIH:** It is a member of the LPXRF-amide family of peptides. Recently A peptide from the LPXFR family has been found in goldfish. But still not clear whether GnIH acts as a releasing or inhibiting hormone in teleosts.
- Dopamine has an inhibitory action on LH secretion. Dopamine antagonists such as domperidone and Pimozide added to GnRH analogs.
- **Kisspeptins:** A family of peptides Encoded by kiss 1 gene and belonging to the superfamily of RF-amide peptides. Kisspeptin receptor (GPCR54) mutation leads to complete impairment of reproductive function in humans and mice. GPCR 54 was expressed by tilapia GnRH neurons and varied between mature and immature fish. It suggests a role of the Kiss family of peptides in pubertal development.

Endocrine control in reproduction physiology in fishes:

The various environmental signals, mainly photoperiod and temperature but also visual-olfactory stimulus, social factors, water characteristic and quality, food availability, presence of substrate, etc., are perceived by the sensorial system of the fish and sent to the brain which reacts throughout the activation of multiple neuronal circuits which finally will act on the pituitary and stimulate gonadotropin (GtHs) synthesis, secretion, and release to the blood. These are responsible for steroidogenesis which in turn are the cause of the events leading to gamete production.

Gametogenesis is the creation of gametes by the meiotic division of gametocytes into various gametes. Males and females of a species that reproduce sexually have two different forms of gametogenesis: spermatogenesis (male) and oogenesis (female).

In a broad sense, oogenesis is the process by which primordial germinal cells become oocytes ready to be fertilized. Primordial germ cells (PGCs) are the embryonic precursors of the gametes. In most species, PGCs spend much of their early development as nomadic residents within other developing tissues. Once they reach the gonad, germ cells undergo a sexually dimorphic process of differentiation that eventually (after days, weeks or years, depending on the organism) culminates in reductive divisions (meiosis) giving rise to the haploid sperm or egg. Once PGCs have differentiated into oogonia these transform into oocytes (onset of meiosis).

In most teleost fish, after gonadal sex differentiation or at the beginning of each reproductive cycle a fraction of oogonia, present in the ovary, undergo a series of mitotic divisions followed by their entry into meiosis (transformation into oocytes). The mechanisms controlling oogonial selection, proliferation and meiotic commitment are largely unknown.

During previtellogenic growth occurring at the beginning of the first meiotic arrest, the diameter of the ovarian follicle increases. The nucleoli produce large amounts of ribosomal RNA as well as mRNA that encode proteins required for subsequent oocyte growth such as vitellogenin receptors and yolk processing enzymes (cathepsins). Also, large amounts of glycoproteins are synthesized by the oocyte during mid to late previtellogenic growth. These are incorporated into alveoli in the periphery of the oocyte. Cortical alveoli are important structures because

they participate in the cortical reaction to fertilization. Oocyte lipid deposition is generally initiated during this step of oocyte growth. Finally, structural changes take place at the periphery of the ovarian follicle. The chorion or vitelline envelope (VE) starts to be deposited at the periphery of the oocyte and with its thickening, the microvilli (the intimate connection between the granulose and the oocyte) elongate to maintain contact

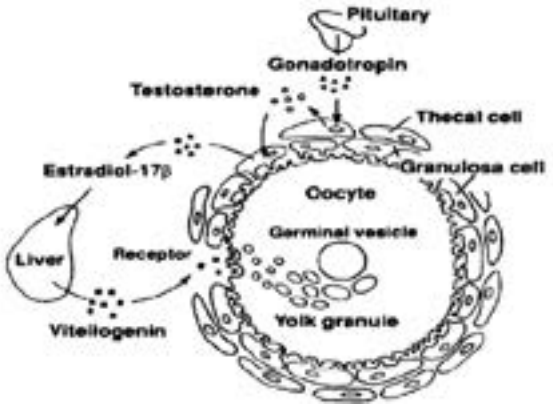


Fig. 3. Process of endocrine control of vitellogenesis in fishes

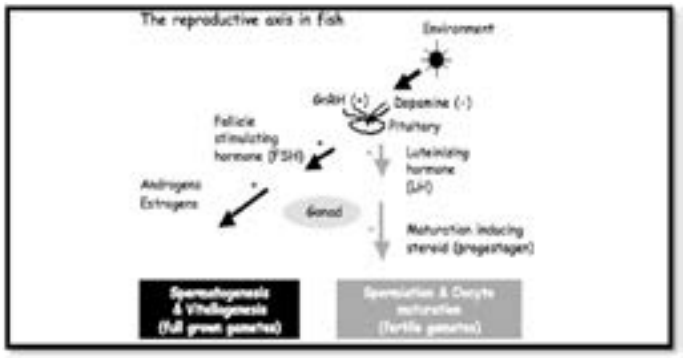


Fig.4. Reproduction process in fishes

with granulosa cells via channels traversing the chorion (zona radiata). Early previtellogenic growth is known as gonadotropin regulated.

Late previtellogenic growth probably is gonadotropin regulated, at least the production of VE that is controlled by ovarian estrogens which in turn, are controlled by pituitary gonadotropins mainly FSH. Vitellogenins are sequestered by the follicles to be incorporated into the oocyte as the yolk. Ultrastructural studies demonstrate a possible route for the Vtg passage from the blood capillaries, via the extracellular space among the theca cells, across the basal lamina, through the spaces between adjacent granulosa layer, around the microvillar projections of

the granulosa and those of the oocyte and across the channels of the zona radiata to make contact wit the oolema.

On the oolema the Vtg binds to specific receptors. The Vtg-receptor complex is internalized by the formation of coated pits. These pinch off the oolema to form coated vesicles in the ooplasm that fuse with lysosome-like multivesicular bodies, were the first cleavage of Vtg occurs to form the yolk proteins, giving rise to the yolk granules or globules. The degradation of Vtgs to form yolk proteins is carried out by the lysosomal enzymes the cathepsins.

The action of the gonadotropin is mediated by the follicular production of 17 beta Estradiol biosynthesized by ovarian follicles via interaction of two cell layers, the theca, and granulosa (two-cell-type model). The granulosa cell layer provides these steroid mediators but its production depends on the provision of the precursor steroid (Testosterone) by the thecal cell layer. Thus, both theca and granulosa cell layers cooperate in the production of steroidal mediators of oocyte growth. Gonadotropin (FSH) acts on the thecal and granulosa cell layers to stimulate testosterone and its aromatization to estradiol, respectively, through a receptor-mediated adenylate cyclase cyclic-AMP system. In non-salmonid teleost fish, the few existing pieces of evidence indicate that the process would be similar. Nevertheless, in other teleosts such as Fundulus or medaka, steroidogenic thecal cells are not evident and the granulosa cells are the major sites for steroid synthesis.

ENDOCRINE CONTROL OF MATURATION:

In teleosts, oocyte maturation is regulated by three major mediators: gonadotropin, maturation inducing hormone (MIH), and maturation-promoting factor (MPF).

Recent shreds of evidence indicate that LH and not FSH are responsible for the induction of follicular maturation in teleost. Thus, in response to an LH surge promoted by environmental, social, or pheromonal stimuli, the oocyte will acquire maturational competence.

That is, the follicle enclosed oocyte resumes meiosis when stimulated with MIH. To summarize, the term ovarian follicle maturation is defined as the suite of LH-induced changes that are necessary for the resumption of meiosis. Similar to the situation during vitellogenesis a two-cell model has been described for the maturing follicle. According to this model 17 α-hydroxyprogesterone formation occurs in the theca cells. These steroids diffuse into granulosa cells to be converted into 17alfa-20 beta-dihydroxy-4-pregnen-3- one (DHP). The two cell type model production of DHP does not apply to all teleost as occurred for the production of E2, in certain teleost species the presence of the theca layer is not required. In other fishes 17alfa-20beta- 21trihydroxy-4-pregnen-3-one (20-beta S) acts as well as an MIH. The MIH binds to membrane receptors (MIHR) which number increases during final maturation. Shreds of evidence are suggesting that the binding of MIH to MIHR inhibits adenyl recycles activity, as a consequence, the decline of c-AMP levels appears to activate cytosolic maturation promoting factor (MPF) which directly is responsible for triggering the resumption of meiosis. MPF is a complex consisting of the cell cycling regulator cdc2-kinase and cyclin B. MIH induces oocytes to de novo synthesize cyclin B which in turn activates the preexisting cd2-kinase through its threonine phosphorylation, producing the active cd2-kinase.

ENDOCRINE CONTROL OF SPERMATOGENESIS:

There are not many studies regarding hormonal control of the renewal of spermatogonial stem cells, nevertheless, in the Japanese eel, it has been demonstrated that it is stimulated by E2. Sertoli cells seem to be implicated in this action since they pose estradiol receptors.

The shift from the renewal of spermatogonial germ cells to spermatogonial proliferation leading to meiosis is gonadotropin dependent. Gonadotropins cause a surge in the secretion in the androgen 11-Ketotestosterone (11-KT) in the Leydig cells. 11-KT stimulates Sertoli cells to produce several mediators such as Activin B and Insulin-like growth factor (IGF-I). In the Japanese eel, 11KT initiates spermatogenesis whereas it seems that IGF is necessary to continue it. Activin B induces spermatogonial proliferation but not meiosis.

An additional member regulating spermatogonial proliferation is the so-called Spermatogenesis Related Substance SRS21, which amino acid sequence shows a great similarity with the Mullerian Inhibiting Substance (MIS). Recombinant eel-SRS21 suppresses spermatogonial proliferation induced by 11-KT. Thus it seems that spermatogonial proliferation is regulated by the rivalry between Activin B and SRS21.

FSH receptors at least in mammals are expressed in the Sertoli cells and thus FSH directly regulates its function. Although in fish the situation is not clear and it is claimed that an important role of FSH would be to modulate the

release of growth factors by Sertoli cells. Also, FSH could participate in the stimulation of Sertoli cell proliferation. The accomplishment of the fertilizing capacity takes place in the sperm duct and is referred to as sperm maturation or capacitation which is accompanied by fluid production (hydration). After two meiotic divisions, the germ cells develop into spermatids.

The spermatids transform into spermatozoa through spermiogenesis. This process is characterized by the occurrence of important morphological changes associated with the formation of the sperm head with a condensed nucleus, a midpiece, and a flagellum. In teleosts, it is not yet clear whether a regulation mechanism exists in spermiogenesis.

That is if spermiogenesis takes place without hormones. Once spermiogenesis is completed sperm is not yet capable of fertilizing the eggs.

In salmonids, spermatozoa acquire the ability of motility during their passage through the sperm duct. Sperm maturation the passage form non-functional gametes to mature spermatozoid involves physiological but not morphological changes. Sperm maturation is regulated by the endocrine system, in some teleost, it has been suggested that 17 alpha, 20 beta-dihydroxy-4-pregnen-3-one (DHP) is related to the regulation of sperm maturation. These progestagen does not act directly in the sperm; Its action is mediated through an increase in the seminal plasma pH, which in turn increases the sperm content in cAMP allowing the acquisition of sperm motility.

Nevertheless, the mechanism by which DHP increases the seminal plasma pH remains unclear. Recently a factor related to the regulation of the increase in pH has been cloned from the testis of Japanese eel. This factor called SRS22 is a homolog of a Carbonic anhydrase (CA) involved in the regulation of ion acid-base balance in various fluids and tissues. The following mechanism has been proposed. Successive elevations of plasma T and 11KT levels were observed before peaks of progestagens, which resulted from the shift in gonadal steroidogenesis and coincided with increases in sperm production. This suggests a mechanism, based on shifts in gonadal steroidogenesis, which may be responsible for the regulation of waves of Spermiation in sea bass.

Pineal gland through its secretion melatonin has been shown to influence the release of ova by promoting assembly of maturation promoting factor and also helps to protect the ova from damage by free radicals.

CONCLUSION

A better understanding of mechanisms controlling reproduction will help us to devise methods for inducing reproduction in a confined environment by hormonal manipulation. It will also help to develop strategies for advanced maturation and prolonging the breeding season of candidate species.

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Crab collection and tiger-widows in Indian Sundarbans

Highlight Points

Collection of economically-important adult mud crabs Scylla serrata and S. olivacea from Indian Sundarbans region in WB is remunerative, but, at the same time, is a risky affair. Tiger-widows in this region, whose number has gone upto 3000 since year 1980, are involved in this activity as they have no other means of living. In January 2019, author had an opportunity to interact with some of them at Bali island under Gosaba PS in South 24 Pgs and got genuine information on the state-of-the-art of crab fishing. Important features of this activity have been presented here.

Subrato Ghosh

Introduction and background

"A 50-year old man was lifted by a tiger while he was collecting crabs in Pirkhali forest in Sundarbans" (Source: The Times of India, September 8, 2009). "Sheba Mridha was widowed couple of months ago when a Royal Bengal Tiger killed her husband Ramesh Mridha (aged 32) as hewas catching crabs in the creeks of Sundarbans Tiger Reserve" (Source: The Economic Times, October 27, 2009). "In March 2015, Amal Mandal, a man of Emilybari in Satjelia GP of Gosaba Block, South 24 Parganas, was mauled by a tiger while collecting crabs in the forest creeks near the island of Pirkhali, a core area within the Sundarban Tiger Reserve. He is survived by his 26-year-old wife, a daughter studying in 4th standard, and a differently-abled

son. His family has been left penniless and without food".

Likewise, there have been several reports in English and Bengali newspapers in last 25-30 years about professional fishermen and crab collectors falling prey to tigers in Indian Sundarbans region in West Bengal. Every year, scores of fishermen in the Sundarbans are killed by tigers while catching crabs in the creeks (Source: Telegraph India, May 12, 2018). The marginal fishermen who live in-and-around Sundarbans usually make 8- to 12-day fishing trips, during which they collect as many adult crabs as possible from the creeks of this mangrove forest. Crab fishers sell their catch (which has international demand) to depots installed by traders, middlemen and exporters in small towns surrounding Indian Sundarbans. Crab collectors are often taken by tigers at times when they are concentrating on their catch.

Conversation with tiger widows

While explaining the method of mud crab grow-out culture and fattening in tide-fed small ponds, intimate conversation was made by author with fifteen tiger-widows at Dakshin Bijoynagar village, Bali-II GP, Gosaba Block, South 24 Parganas, WB. Following the profession of their husbands, these underprivileged women collect adult mud crabs Scylla serrata and S. olivacea from Durgaduani, Tentulberia, Gazirkhal, Keoratoli creeks and other brackishwater river channels and creeks surrounded by Hetal and Goran trees near Pirkhali and Pakhiralay forests in Indian Sundarbans and supply it to crab wholesale markets at Sandeshkhali, Najat, Dhamakhali and other places. Durgaduani creek runs between Gosaba island and Bali-Bijoynagar island. In 2-3 days a month during ebb tide, two women move out in 5.4-6.8mt long oar-driven country boats at 3.00am, travel 32-45km distance to reach at crab fishing zones (water depth 1.80-2.20mt) at 7.30-8.00am. After harvest, they move towards home at 2.00pm or later during high tide.

30nos hooks are used for long nylon rope (main line) 120-180 hands in length ('haath' in local dialect, 1 haath / hand = 17 – 21 inches) and total bait used 4-5kg (i.e., 28-30 roundly-cut pieces of mud eel Monopterus cuchia, immersed in salt solution before use). For 3-4 times longer ropes, 9kg bait used. Hooks or iron jigs are used, and bait attached to them, one in each at bottom end. According to some other women, for every rope 1000 hands in

According to some of these women, in crab fishing, 28-length, iron hooks amounting to 8kg are used, 800-850 in number and same number of cut pieces of M. cuchia used as baits ('char' in local dialect). During high tide, 4-5kg and 8-10kg crabs (200-400gm each, males more in number) are harvested by women per boat in each of three days in month in summer and winter months respectively. After 20-30mins of placing the hooks and line, rope is uplifted from one end when boat propelled along waterway till other end. Harvested crabs 100-150gm in size are sold @ Rs 80-150/- / kg, 300-400gm

@ Rs 350-450/- / kg, which move into creeks during high tide and catch hold the baited hooks.

Greater amount of adult crabs are caught during winter season, and more is caught in narrow brackishwater creeks. Every group of two women earn Rs 4000-5500/- / month, plan and give efforts collectively. They have to pay money to owner of country boats. According to these women crab collectors, adult mud crabs can be caught more in number in deeper areas of Indian Sundarbans, at thick mangrove forest on the other bank of Ganral river at Gosaba delta and other places, where the risk is also greater. All of them have lost their husband, and few of them even their son; who went for crab fishing but did not returned back home. These women have to risk their lives in this kind of livelihood, and crab collection is their only means of living.

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Medicinal Plants in Aquaculture

Highlight Points

- Medicinal plants are the best alternative to antibiotics which is being used to control infectious diseases in aquaculture system.
- They are also cheaper than commercially available drugs.
- The side effects caused by these natural plant extracts are very low

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Introduction

Aquaculture is the fast-growing animal food-producing sector. However, aquaculture growth is often linked to culture intensification, leading to overcrowding & poor water quality, facilitating the spread of the pathogen and increasing disease outbreak and mortality. In order to avoid economic loss related to sanitary shortcoming veterinary drugs are commonly used in aquaculture. The intensive use of synthetic drugs presents numerous disadvantages for both the environment & health. Considering the numerous disadvantages of synthetic drugs there is an increasing need for alternative strategy in aquaculture disease management.

Medicinal plants in aquaculture

Medicinal plants can provide a cheaper and more sustainable alternative to chemotherapy. Although interest in the use of medicinal plants and plant extract in aquaculture has exploded recently, medicinal plants have long been used by rural fish farmers. A survey in Indonesia (West Java) reported that 46% of fish farmers used plants in the farm which were traditionally used in the human pharmacopeia. In most cases, fresh plants were directly introduced into the rearing water and used to improve water quality, reduce fish stress, Increase fish resistance to pathogen & treat fish disease.

Source of medicinal plants and active compounds

In traditional Chinese human medicine, medicinal plants have been used as immunostimulants for thousands of years. Medicinal plants have been used in human medicine as immune boosters for millennia. Furthermore, they are alternatives to antibiotics in aquaculture. Analysis of plant bioactivity showed that 36% of plants studied presented antibacterial activity whereas, 17% had antiparasitic activity, 16%immunostimulant activity,14% antiviral activity, 13% growth promoters and only 4% showed antifungal activity.

A diverse range of herbs are used in aquaculture including aloe (Aloevera), almond (Terminalia catappa),basil flowers(Ocimum sanctum), caraway seed meal (Carumcarvi L.), cinnamon (Cinnamomumzeylanicum), garlic (Allium sativum), ginger (Zingiberofficinale), ginseng (Panax ginseng), American ginseng (P. quinquefolium), green tea (Camellia sinensis L.), Arabic coffee bean, Coffee Arabica, guava (Psidiumguajava), heartleafmoonseed (Tinosporacordifolia), olive tree leaf (Oleaeuropaea), papaya leaf, peppermint (Menthapiperita), purple coneflower (Echinacea purpurea), quillajasaponins (Quillajasaponaria), seaweeds (Sargassum spp.), tulsi (Ocimum sanctum).

According to Bulfon et al., (2015), more than 60 different medicinal-plant species have beenstudied for the improvement of fish health and disease management in aquaculture.

Several parts of these medicinal plants are used to extract the active substances. Leaves are mostly used as well as roots, rhizome, fruits, seeds, barks and bulbs.Plant leaves are abundantly used with 37%, while 22% used the whole plant as powder, plant essential oil and extract. Roots were often used at 18%, followed by seeds (8%), barks (6%), fruits (6%) and finally fruits (4%). Medicinal plants are rich in various secondary metabolites and phytochemical compounds, such as tannins, alkaloids, and flavonoids, which affect various diseases in fish.

These active substances are mostly extracted with methanol, ethanol, ethyl acetate, diethyl ether, petroleum ether, chloroform and water.The antibacterial property of numerous plants is against both gram-positive & gram-negative marine bacteria. It also seems to be an effective alternative for treating ectoparasite.

Biological activity in aquatic animals

Methanolic herb extract is extracted fromCynodondactylon, Piper longum, Phyllanthusniruri, Tridaxprocumbens, Zingiberofficinalis. Groupers fed with supplement diet of a mixture of methanolic herb extract displayed 41% higher weight than controlled fish. It also improved the digestibility and availability of nutrients, resulting in increasing feed conversion and leading to higher protein synthesis.

Nile tilapia fed with mistletoe (Viscum album coloratum) for a period of 80 days resulted in 42% increased survivability when they were challenged with Aeromonashydrophila. It also improved immune parameters and hematological parameters.

When black tiger shrimp challenged with white spot syndrome virus (WSSV) being treated with Bermudagrass(Cynodondactylon) displayed no mortality & no sign of disease compared to 100% mortality observed in the control group.

Olive flounder fed with Suaeda maxima showed 40% mortality decrease & enhanced immunity when it was challenged with protozoan ciliate.

When an enriched diet of garlic (Allium sativum) given to barramundii for 30 days displayed 70% decreased Neobenedeniasp infection.

Asparagopsistaxiformisenhanced the immune system of P. monodon was highly efficient in the treatment of vibriosis.

Most widely used plants in aquaculture

S.NO	Medicinal plants	Parts used	Component	Biological effect
1	Papaya	Seeds	Tannins, papain, nicotine, cyanogenic glucosides, and quercetin	Antiparasitic
2	Prickly chaff flower	Seeds	-	Antibacterial
3	Garlic	Bulbs	Allicin, ajoene	Antiparasitic
4	Chinese cinnamon	Tree bark	Cinnamaldehyde, cinnamon oil, eugenol, salicylaldehyde, and trans-cinnamic acid	Antiparasitic
5	Limukohu	Seaweed	Halogenated alkanes, alkenes, alkynes, and acrylic acid	Antiparasitic
6	Scutch grass or Bermuda grass	-	Cynodin, hydrocyanic acid, triticin, and beta-carotene, gallic acid, tannin, anthocyanin, flavonoids	Antiparasitic, antibacterial, antiviral
7	Asthma-plant	Leaves	Leukocyanidol, quercitol, camphol, quercetin, Dihydroellagitannins, and dimeric hydrolysable tannin – euphorbian	Antibacterial
8	Holy Basil	Leaves	Ursolic acid, oleanolic acid, and salrigenin	Antibacterial
9	Pomegranate	Leaves	Polyphenol, ellagitannins	Antioxidant, anti-inflammatory agent, antiviral.
10	Ginger		Polyphenols, flavonoid,saponins, zingerone, shogoals & sesquiterpenoids	Antioxidant, anti-inflammatory agent, apoptosis induction
11	Rosemary	Leaves	Polyphenols	Antibacterial
12	Ashwagandha (Indian Ginserg)	Roots	Alkaloids,steroidallactones,saponins,and withanolides	Antibacterial
13	Indian Almond	Leaves	Punicalin	Antiparasitic
14	Padinagymnosp	Seaweed	Squalene,lupeolacetate,betulin,andtaraxasterol	Antibacterial
15	Velvet bean	Leaves	L-dopa,phenols,tannins,saponins,nicotine, physostigmine,bufotenine,serotonin, N,N-dimethyltryptamine,and5-methoxy-DMT	Antiparasitic
16	Turmeric	-	Polysaccharide	Antibacterial
17	Fig	*-	Polysaccharide	Antibacterial
18	Tea plant	Leaves & buds	Catechins	Antiparasitic
19	Chinaberry (malaivembu)	Bark	-	Antiparasitic
20	Olive	Leaves	Biophenols	Antiviral

Mode of action of medicinal plants

The methods of applying medicinal plants in aquaculture include Supplementation to the feed, producing an extract, and submerging the fish into it, as well as intraperitoneal injection. The dose depended on the plant extracts, fish species, and the route of application. The effect of medicinal plants is dose-dependent and there is a risk of overdose. Oral application of medicinal plants is a preferred method.

Immune boosting effect

Plant extracts possess different properties such as antistress, growth promotion, appetite stimulation, and immunostimulation and prevent diseases in fish aquaculture.

Plant name	Preparation	Dose	Plant name	Preparation
Holy basil	Water extract	Feed additive- 0.05,0.1,0.2,0.5,and1% for 42 days	Rohu Fish	Aeromonashydrophila
Ashwagandha/ Indian ginseng	Powder	Feed additive- 1.2and3g/kg for 42 day		
Ginger	Powder	Feed additive- 5and10g/kg feedfor 15days	Sea bass	Vibrio harveyi
Rosemary	Dryleaves, dried ethyl acetate extract	Feed additives- 3:17and1:24 ratios(w/w) for 5days	Tilapia	Streptococcus iniae
Indian lettuce	Powder	Feed additives- 1 and 2% for 4 weeks	Longtooth grouper	

These activities are produced in part by alkaloids, terpenoids, tannins, saponins, glycosides, flavonoids, phenolics, steroids, and essential oils present in the plants. Reactive oxygen and nitrogen species are toxic for bacteria causing illnesses in fish. Reactive oxygen species produced by neutrophils and macrophages could kill bacteria and thus, constitute a primary element of non-specific defense in fish. Astragalusmembranaceusand Lonicera japonica enhanced substantially phagocytic and respiratory burst activities in tilapia.

Antiviral activity

The most important viruses that cause high mortality rates in fish aquaculture are infectious hematopoietic necrosis virus, infectious pancreatic necrosis virus, hiramerhabdovirus, yellowtail ascites virus, striped jack nervous necrosis virus, and iridovirus. The antiviral effect of plants is due to inhibition of virus transcription and reduction of its replication in the host cells, thus, enhancing the innate immune response of the host.

Antibacterial activity

The antibacterial properties of medicinal plants are the most investigated with application in aquacultures and it is well known that these plants have antibacterial activity against Gram-positive and Gram-negative bacteria. Most of these are administered against Aeromonashydrophila, Vibrio parahaemolyticus, Vibrio harveyi, Vibrio carchariae, Vibrio splendidus, Streptococcus iniae, Edwardsiellatarda, Pseudomonas aeruginosa, and Streptococcus agalactiae.

Plant name	Preparation	Dose	Fish	Antiparasitic effect
Garlic	Aqueousextract	Bath-7.5and12.5ml/l for1h	Guppy	Gyrodactylusturnbulli
Tea	Extract	Bath- 0.3–0.9%for1–5min	Chum salmon, masu salmon	Ichthyobodonecator
Chinaberry	Methanol extract	Bath- 381mg/lfor48h	Gold fish	Gyrodactyluskobayashii
Velvet bean	Methanolicextractofleaves	Bath- 200mg/lfor72h	Gold fish	Ichthyophthiriusmultifiliis
Papaya	Petroleum ether extract of seeds	Bath-200mg/lfor96h		

Conclusion

Many herbal medicines are not well researched in terms of their mechanisms of action and toxicity. Enhancement of the immune system is the most promising method of preventing fish diseases, in which vaccines are considered to be the most effective agents, but a single vaccine is effective against only one type of pathogen, and no effective vaccine is available to protect against many pathogens due to the complex antigenic structure, while aquatic animals are in contact with numerous pathogens in their habitat. Medicinal herbs provide potential agents to act as vaccines. All in all, the protocols for the use of medicinal plants in aquaculture will continue to be generated at a confident level. Commercially available herbal products will be strongly recommended in the global market for large scale use in aquaculture.

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